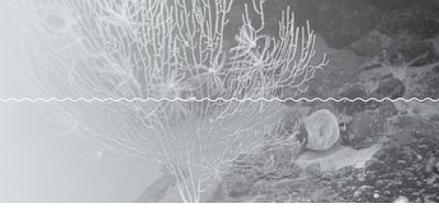




## WATCHING IN 3D

Exploring with Multibeam Sonar



# CASE STUDY 3: Exploring a Seamount

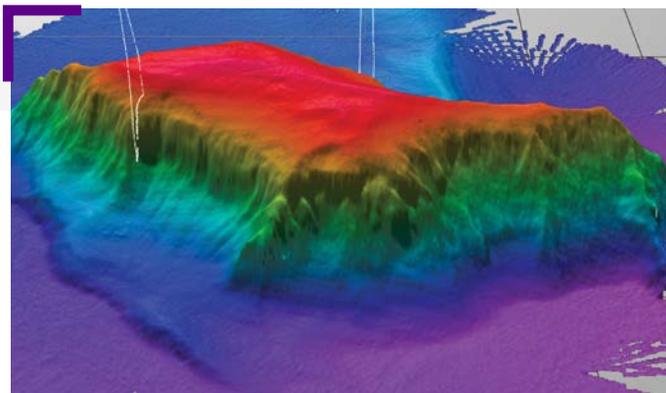
(Mytilus)

## What is a Seamount?

Most seamounts are remnants of extinct volcanoes. Typically, they are cone shaped, but often have other prominent features such as craters and linear ridges and some, called guyots, have large, flat summits. To be classified as a seamount the feature must have a vertical relief of at least 1,000 meters (3,300 feet) above the surrounding the seafloor.

Seamounts are found in every world ocean basin and while it is not known precisely how many seamounts there are, they are very numerous. Based on data from satellite altimetry and bathymetric mapping data obtained from survey ships, the number of seamounts that are at least 1,000 meters high is thought to be greater than 100,000. Despite their abundance, however, less than one-tenth of a percent of the seamounts in the world have been explored.

Studies conducted over seamounts indicate that they function as “oases of life,” with higher species diversity and biomass found on seamounts and in the waters around them than on the flat seafloor. They rise up high in the water column, creating complex current patterns influencing what lives on and above them. Seamounts also provide substrate (a location for attachment) where organisms can settle and grow. These organisms provide a food source for other animals. Scientists have found that seamounts often provide habitat to endemic species, or species found only in a single location.



Fledermaus 3D image of Mytilus Seamount.

Four key technologies are used to gather baseline information on areas of ocean exploration:



**Listen**  
Multibeam sonar mapping system



**Test**  
Conductivity, Temperature and Depth profilers (CTDs)



**Photograph**  
Remotely Operated Vehicles (ROV)



**Share**  
Telepresence technologies

 [NOAA Ocean Exploration Data Atlas](#) (a searchable, interactive expedition data map) and a demonstration video of [Fledermaus](#), a mapping data visualization software used by ocean explorers to view multibeam sonar data and imagery in 3D. [Multibeam sonar](#) is one of the most powerful tools available for modern deep-sea exploration, and can create high-resolution maps and three dimensional models.

 You will also be introduced to the NOAA Ocean Exploration website and the [2013 Northeast U.S. Canyons Expedition](#) where Mytilus Seamount was studied.



## What Seamount are we Exploring?

The New England Seamounts are a chain of extinct submarine volcanoes that extend from east to west across the North Atlantic Ocean. The chain was created by the movement of crustal plates across a relatively stationary “hot spot” plume of magma, deep in the Earth’s mantle. This same hotspot created New Hampshire’s White Mountains as it migrated eastward under the North American Tectonic Plate. The youngest and easternmost seamount (Great Meteor) formed approximately 80 million years ago and the oldest and westernmost seamount (Bear) formed approximately 100 million years ago. A detailed description of the geology of the New England Seamount Chain is [available here](#).

During the [Northeast U.S. Canyons and Seamounts Expedition in 2013](#), a team of scientists and technicians both at sea and on shore conducted exploratory investigations on the diversity and distribution of deep-sea habitats and marine life along the Northeast U.S. Canyons and within the seamount chain, including a close look at Mytilus Seamount. This seamount was found to be a lush “biological island” in the deep sea.



### One Seamount, Two Dives

During this expedition, we explored Mytilus Seamount on two separate dives, one on the north side and one on the south side of the seamount. Mytilus is part of the New England Seamount Chain and is one of the deepest (over 3,000 meters at the base) and least-explored seamounts in the U.S. Exclusive Economic Zone.



### Exclusive Economic Zones (EEZs)

are areas of the sea, generally extended 200 nautical miles from a country’s coastline. Within this zone, coastal countries retain special rights to exploration and the use of marine resources.

[Check here for more information on the U.S. EEZ.](#)



This deep-sea lizard fish (Bathysaurus) was observed on the south side of Mytilus Seamount. This fish sits on the bottom and grabs prey from the water column. *Image courtesy of NOAA Ocean Exploration, Northeast U.S. Canyons Expedition 2013.*



### Witch’s Hat Sponge

Sponges are abundant and diverse at Mytilus Seamount. Notice this large “witch’s hat” sponge provides structure for numerous glass sponges as well as some orange brittle stars.



*Image courtesy of NOAA Ocean Exploration, Northeast U.S. Canyons Expedition 2013.*

## Student Investigation: Exploring Seamounts with Multibeam Sonar Tools

### TOOL 1: Exploring a Seamount with the NOAA Ocean Exploration Data Atlas

Now that you know more about seamounts, let's use the NOAA Ocean Exploration Data Atlas to explore this feature.

#### OPEN THE ATLAS LINK:

▶ <https://www.ncei.noaa.gov/maps/ocean-exploration-data-atlas/>

#### INPUT THE EXPEDITION DETAILS:

**Minimum Y(ear):** 2013

**Maximum Y(ear):** 2013

**Expedition Name:** EX1304L2 (select code in the left hand drop down menu), Northeast U.S.

Canyons Expedition (expedition name will appear in the right hand sidebar)

**Platform Name (vessel):** NOAA Ship *Okeanos Explorer*



**EX1702:** "EX" is used as an abbreviation for the NOAA Ship *Okeanos Explorer*, the last two digits of the year of the cruise (13), the number of the cruise (fourth-04 cruise for 2013), and the segment or leg (second leg-L2 of cruise 04).

#### CLICK ZOOM TO RESULTS

**PLOT ON MAP:** Use your center mouse button to zoom in until the names of the ROV dives appear.

**LOOK CLOSER:** Holding the left mouse button down, shift the map and zoom in to find Mytilus Seamount and the Remotely Operated Vehicle (ROV) Dives 4 and 5 (EX1304L2\_DIVE 04 and 05). Discuss the following questions with your group.

1. What do you think the ship was doing here to make those lines on the map? Can you think of anything in your life that makes similar patterns? \_\_\_\_\_

\_\_\_\_\_

**DIVE IN:** Zoom in to see the flat top of Mytilus Seamount.

2. What else do you notice? \_\_\_\_\_

**ZOOM OUT:** Zoom out farther to see where this seamount sits on the globe.

3. Describe its location. \_\_\_\_\_

\_\_\_\_\_

4. Zooming in and out around the seamount, what other seafloor features do you notice/recognize on the map?

\_\_\_\_\_

## Student Investigation: Exploring Seamounts with Multibeam Sonar Tools *cont.*

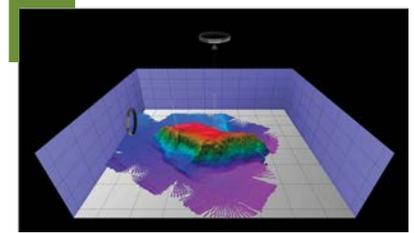
### TOOL 2: Exploring a Seamount with Fledermaus



Now that you have found these two ROV dives, you will view a video exploration of Mytilus Seamount within a platform called Fledermaus. This is a three-dimensional data visualization system used to view and manipulate 3D models of seafloor features, provide insight into the geological structure of an area and help to pinpoint ideal locations for further exploration. Use the video to help you discuss and answer the questions below.



Fledermaus, pronounced "FLEE-der-mouse," is the German word for bat.



#### WATCH: [CASE STUDY 3 FLEDERMAUS VIDEO](#)

**EXPLORE:** Based on your video observations, answer the questions below.

1. What is the width of the seamount from east to west? \_\_\_\_\_  
What is the length of the seamount from north to south? \_\_\_\_\_
2. What is the deepest point of this seamount? \_\_\_\_\_ What is the shallowest point? \_\_\_\_\_
3. What appears to be the steepest slope on this seamount in degrees? \_\_\_\_\_

#### THINK ABOUT IT

4. What might be the reason this seamount has a flat top? \_\_\_\_\_
5. What organisms might live here? Why? \_\_\_\_\_  
\_\_\_\_\_
6. Why do you think the scientists selected these dive locations? \_\_\_\_\_
7. If you were the scientist leading this expedition and exploring this seamount for the first time, where would you choose to send the ROV? \_\_\_\_\_  
\_\_\_\_\_
8. What considerations do you think need to be made when deciding what regions to select for further exploration? \_\_\_\_\_  
\_\_\_\_\_

## Student Investigation: Exploring Seamounts with Multibeam Sonar Tools *cont.*

### TOOL 3: Expedition Web Pages

Now that you have explored the 3D map of the Mytilus Seamount, check out the Northeast U.S. Canyons Expedition **EXPEDITION WEB PAGE** on the NOAA Ocean Exploration website to learn more about what was studied here and some of the discoveries that were made..

- ▶ <https://oceanexplorer.noaa.gov/oceanos/explorations/ex1304/welcome.html>

#### HERE YOU CAN...

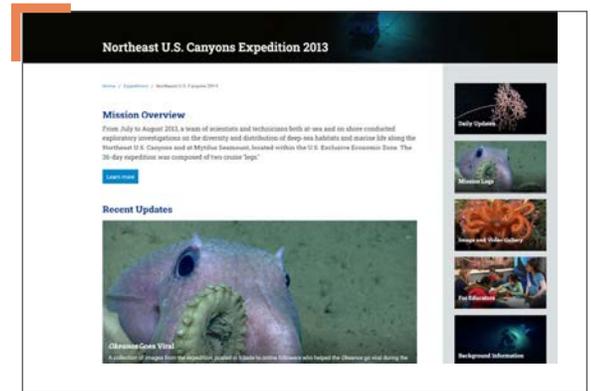
- read the Mission Overview
- read the Mission Logs and Daily Updates
- view beautiful imagery, videos and more!

#### BE THE EXPLORER

##### What was discovered?

On the [Northeast U.S. Canyons Expedition web page](#), click [Daily Updates](#).

READ the [Daily Updates](#) from **August 4, 2013** and **August 5, 2013**.



1. Why did scientists select this seamount for exploration? \_\_\_\_\_  
\_\_\_\_\_
2. What was the deepest point the ROV traveled during these two dives? \_\_\_\_\_
3. What is the primary type of rock present at this seamount? Why? \_\_\_\_\_  
\_\_\_\_\_
4. Why do you think there were more fish found on the south side (Dive 5) of the seamount vs the north side (Dive 4)? \_\_\_\_\_
5. Why do you think the science team made note of three types of black coral? \_\_\_\_\_  
\_\_\_\_\_

List two new things you might want to know about this area. READ the [Mission Log for Aug. 6, 2013](#) to see what the team learned and what is still not fully understood!

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In 2016, the President established the Northeast Canyons and Seamounts Marine National Monument. [Background Essay](#) from the Deep Connections 2019 Expedition for September 15, 2019. Describe why this was important.

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## Seamount Lesson URLs/Links

- Page 1:**
- ▶ Guyots: <https://oceanexplorer.noaa.gov/oceanos/explorations/ex1606/background/guyots-bio/welcome.html>
  - ▶ Seamounts fact sheet (PDF): <https://oceanexplorer.noaa.gov/edu/materials/what-is-a-seamount-fact-sheet.pdf>
  - ▶ Oases of Life fact sheet (PDF): <https://oceanexplorer.noaa.gov/edu/materials/seamounts-oases-of-life-fact-sheet.pdf>
  - ▶ Listen: <https://oceanexplorer.noaa.gov/edu/materials/multibeam-sonar-fact-sheet.pdf>
  - ▶ Test: <https://oceanexplorer.noaa.gov/technology/ctd/ctd.html>
  - ▶ Photograph: <https://oceanexplorer.noaa.gov/edu/materials/rov-fact-sheet.pdf>
  - ▶ Share: <https://oceanexplorer.noaa.gov/technology/telepresence/telepresence.html>
  - ▶ Multibeam Sonar Fact Sheet (PDF): <https://oceanexplorer.noaa.gov/edu/materials/multibeam-sonar-fact-sheet.pdf>
- Page 2:**
- ▶ Hotspots: <https://oceanexplorer.noaa.gov/facts/volcanic-hotspot.html>
  - ▶ New England Seamount Chain: <https://oceanexplorer.noaa.gov/explorations/03mountains/background/geology/geology.html>
  - ▶ Northeast U.S. Canyons and Seamounts Expedition in 2013: <https://oceanexplorer.noaa.gov/oceanos/explorations/ex1304/welcome.html>
  - ▶ Deep-sea lizard fish (photo): <https://oceanexplorer.noaa.gov/oceanos/explorations/ex1304/logs/aug6/media/fish-hires.jpg>
  - ▶ U.S. EEZ (webpage): <https://oceanexplorer.noaa.gov/facts/useez.html>
  - ▶ Witch's hat sponge (photo): <https://oceanexplorer.noaa.gov/oceanos/explorations/ex1304/logs/aug6/media/sponge-hires.jpg>
- Page 3:**
- ▶ NOAA Ocean Exploration Data Atlas: <https://www.ncei.noaa.gov/maps/ocean-exploration-data-atlas/>
- Page 4:**
- ▶ Fledermaus video, Mytilus Seamount: [https://oceanexplorer.noaa.gov/edu/materials/CaseStudy3\\_Mytilus\\_Seamount.mp4](https://oceanexplorer.noaa.gov/edu/materials/CaseStudy3_Mytilus_Seamount.mp4)
- Page 5:**
- ▶ 2013 Northeast U.S. Canyons Expedition Web Page: <https://oceanexplorer.noaa.gov/oceanos/explorations/ex1304/welcome.html>
  - ▶ 2013 Northeast U.S. Canyons Expedition Daily Updates: <https://oceanexplorer.noaa.gov/oceanos/explorations/ex1304/dailyupdates/dailyupdates.html>
  - ▶ Daily Update August 4: <https://oceanexplorer.noaa.gov/oceanos/explorations/ex1304/dailyupdates/dailyupdates.html#cbpi=aug4.html>
  - ▶ Daily Update August 5: <https://oceanexplorer.noaa.gov/oceanos/explorations/ex1304/dailyupdates/dailyupdates.html#cbpi=aug5.html>
  - ▶ Mission Log Aug. 6, 2013: <https://oceanexplorer.noaa.gov/oceanos/explorations/ex1304/logs/aug6/aug6.html>
  - ▶ Background essay, Sept. 15, 2019: <https://oceanexplorer.noaa.gov/oceanos/explorations/ex1905/background/ncsmnm/welcome.html>

## Information and Feedback



We value your feedback on this activity package, including how you use it in your formal/informal education settings. Please send your comments to: [oceaneducation@noaa.gov](mailto:oceaneducation@noaa.gov). If reproducing this lesson, please cite NOAA as the source, and provide the following URL: <https://oceanexplorer.noaa.gov>.